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Short-term effects of the mass dying of Harbour seals in the Kattegat-Skagerrak area during 1988

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Abstract

Studied the effects of the recent mass dying of harbour seals, *Phoca vitulina,* in the Kattegat-Skagerrak area. Results from six aerial surveys in 1988 were compared to trajectories of the trend in the population during 1978–1986. The number of seals declined by 60 % compared to expected values for 1988 and by 47 % compared to 1987. The decline was evident in each of three different subareas indicating that the disease had similar effects in all subpopulations. By using the decline as an estimate of the overall mortality and applying this to the number of dead seals found, an estimate of the expected "true" population size in 1988 (i.e. excluding effects of the epizootic) was achieved. When this is compared to the extrapolated numbers of seals present on land about 77 % of the population is hauled out during the surveys.

Introduction

The development of the European seal stocks is closely linked to anthropogenic influence of which hunting was the most important during the first half of this century (Reijnders et al. 1981; Heide-Jørgensen and Härkönen 1988; Helle et al. 1976). Protective measures during the past decades resulted in increasing seal populations (Hansen 1986; Heidemann 1987; Stede 1987; Reijnders et al. 1981; Heide-Jørgensen and Härkönen 1988), although negative effects of pollutants were identified in some areas (Helle et al. 1976; Helle 1980; Reijnders 1986).

In the summer of 1988 an epizootic disease drastically altered the increasing trends for the harbour seal, *Phoca vitulina,* stocks in the North Sea area. The background for the virus infection and the mechanism behind the dispersal are still unsolved. It was the first well documented incident of mass mortality among free ranging harbour seals in European waters. Available data on the progress and dispersal of the disease and of earlier incidents of mass mortality in pinnipeds is compiled in Dietz et al. (1989).

This study aims to quantify the short-term effects of abortions and mass dying on the seal stocks in the Kattegat-Skagerrak.

Material and methods

Land based systematic observations and counts of seals have been carried out on Anholt (Fig. 1) since 1978. Sand dunes close to the seals were used as platforms for observations, and by using a powerful telescope (×15–25) the seals were counted twice on every occasion and the average numbers were reported. The observation effort was allocated to morning hours (0900) during the moulting season in August.

From 1979 to 1988 aerial surveys of all major haul-out sites in the Kattegat-Skagerrak area were carried out simultaneously in Denmark and Sweden. The aerial surveys were made late in the moulting season, at the end of August, and all haul-out sites were photographed obliquely for later enumeration

of seals on the photos. Days with strong winds or rain were avoided for the surveys, as well as weekends with harassments from tourists. In 1982 and 1987 the surveys were considered unsuccessful in most areas and the results are rejected. In 1988 six aerial surveys were accomplished between 22 and 31 August to estimate the variance of the survey results.

Results from two aerial surveys in Subarea III (see Fig. 1), simultaneous with the surveys in the other subareas, were provided by Ebbe Bøgebjerg Hansen, Danish Game Biology Station.

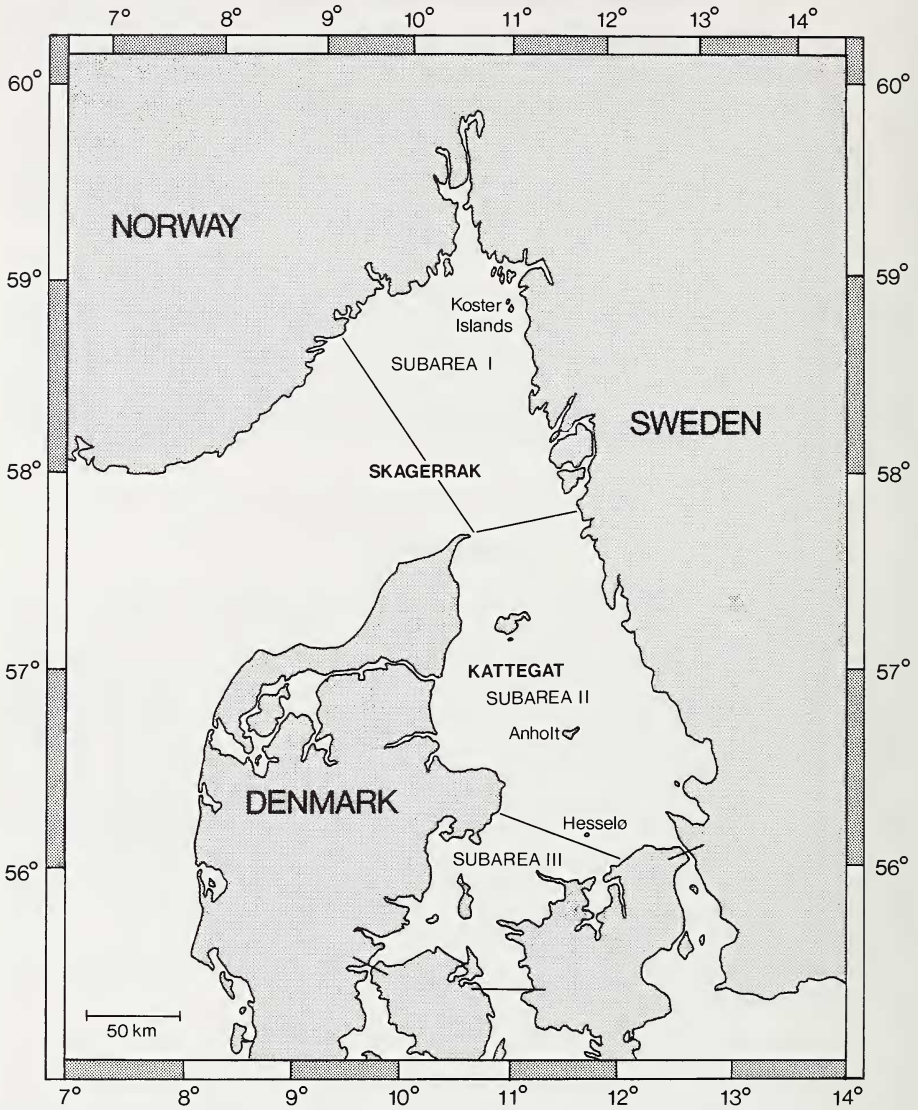

Fig. 1. Map of the area with localities and subareas mentioned in the text

The anticipated population size in 1987 and 1988 if the epizootic had not occurred, was calculated by trajectories of the population trend for the period 1979–1986 with matching confidence limits (see Heide-Jørgensen and Härkönen 1988).

Standard deviation of the log.-transformed data used in predictions for 1988 was calculated according to Sokal and Rohlf (1981, p. 473).

Data on number, age categories and sex classes of the dead seals were preliminarily compiled in Heide-Jørgensen and Härkönen (1989), where even the efficiency of the registration of dead seals is discussed.

Results

On Anholt changes in the coastline has rendered precise enumerations of seal herds more difficult in 1988 than in previous years. Nevertheless, a profound effect of the epizootic on the population at this locality is clearly perceptible from both maximum and mean numbers in August (Fig. 2; Table 1). The exponential rate of increase at Anholt was 0.10

Table 1. **Summary statistics for survey results and mortalities for different subareas**
Confidence limits (95 %) are given in brackets

Area	Anticipated number of seals in Aug. 1988 A[1]	Number of dead seals B[2]	Actual number of seals present during surveys in 1988 C[3]	Overall mortality rate D=(A–C)/A	Calculated population size in 1988 E=B/D	Fraction on land F=A/E
Anholt Max.	660 (542–800)	277	265	0.60	–	–
Anholt Mean	443 (341–574)	277	204 (186–222)	0.54	–	–
Subarea I	1666 (1418–1958)	1469	732 (684–779)	0.56	2623	0.64
Subarea II	4481 (4110–4885)	3164	1967 (1840–2093)	0.56	5650	0.80
Subarea III	806 (520–1249)	745	272 (178–365)	0.66	1129	0.71
Grand Total	7009 (996–7021)	5378	2901 (2497–3305)	0.59	9115	0.77

[1] Numbers are extrapolated from time series between 1978 and 1986 (1987 for Anholt). – [2] See Heide-Jørgensen and Härkönen 1989 for a detailed account of the registration of dead seals. – [3] Numbers were calculated as means of six aerial surveys in Subarea I and II, and three aerial surveys in Subarea III and Grand Total.

and 0.09 for maximum and mean numbers respectively during 1978–1987. Land based surveys on Anholt in 1988 showed that the maximum and mean numbers of seals in August were 265 and 204 respectively, compared to 525 and 341 in 1987 (Table 1). Assessment of the virtual decline on Anholt is subject to the proviso that conditions for precise countings have deteriorated in 1988.

In Subarea I and II six aerial surveys were accomplished in 1988, but in Subarea III only three surveys were carried out. Mean and confidence limits for the entire area is accordingly based on only three surveys. A mean of 2.901 seals with matching confidence limits (95 %) of less than 14 % was obtained for the entire area (Table 1C). In Subarea I and II confidence limits of less than 7 % were acquired. This low variance strengthens the conclusions of the present as well as past surveys.

The total number of harbour seals in the entire Kattegat-Skagerrak population diminished by approximately 60 % (Table 1D) from the anticipated (Table 1A) to the actual number present during aerial surveys in 1988 (Fig. 2; Table 1C). Comparison with expected values for 1987 revealed a decline of 47 %. The decline was of similar magnitude in three subareas, as well as on Anholt, indicating that the disease had a similar effect in all areas.

Assuming that the number of dead seals (Table 1B) represents the overall mortality of 0.59 (Table 1D) a hypothetical population size in 1988, in the case that the epizootic had not occurred, is calculated at 9115 seals (Table 1E). Applying this figure to the extrapolated number of seals present during aerial surveys (Table 1A) reveals a fraction of approximately 77 % of the seals hauled out during the surveys (Table 1F). If a similar fraction of the post-epizootic population of harbour seals in the Kattegat-Skagerrak was present on land during surveys in 1988 then the entire populations amounts to approximately 3768.

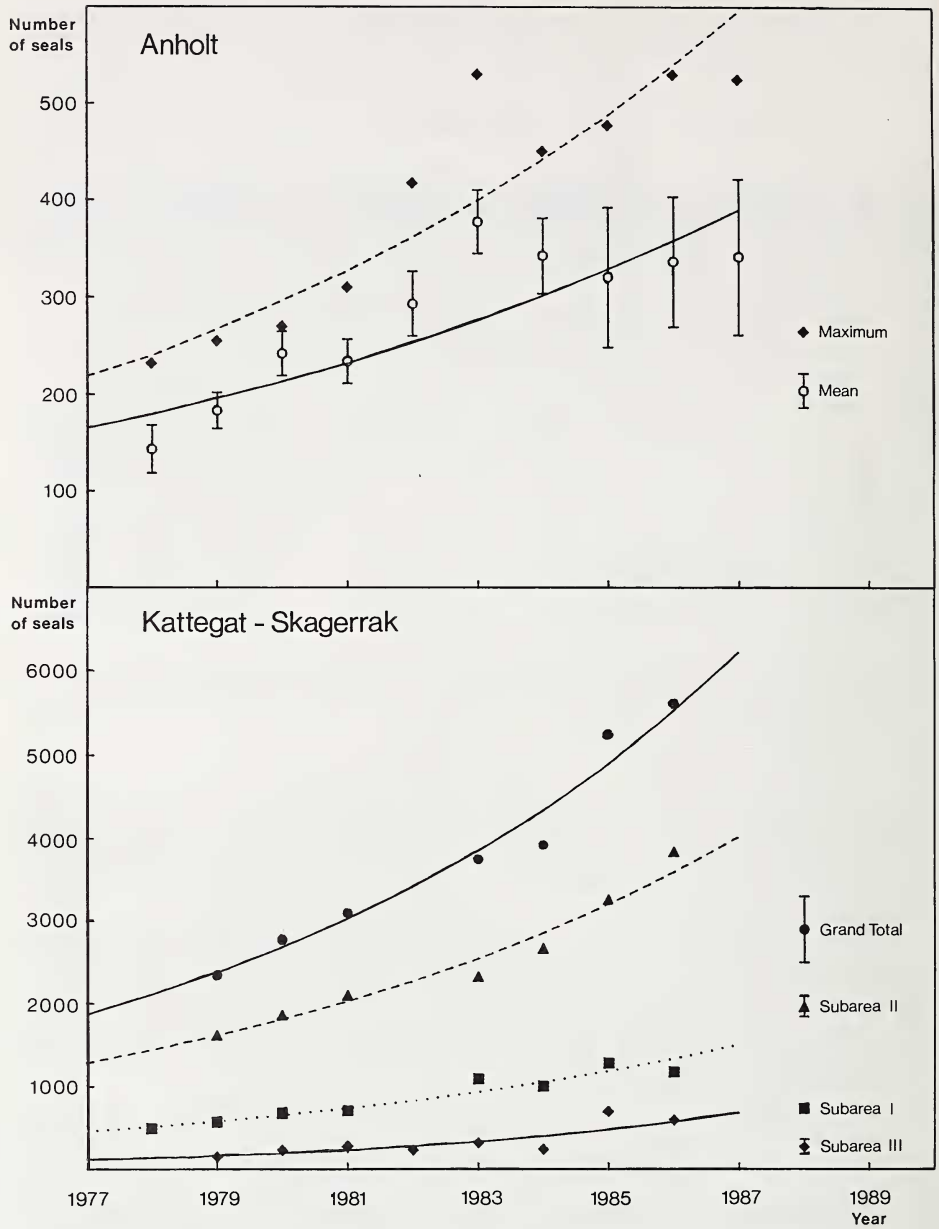

Fig. 2. Time series of surveys of seals on Anholt and in the entire area from 1978 to 1988

The variation between subareas of the fraction of seals on land (Table 1F) may reflect differences in the efficiency with which dead seals were recorded and the fact that corpses may have drifted between subareas. Hence, the estimate of the proportion of seals on land for the entire area must be considered the most reliable.

Discussion

The seal plague had its peak mortality during or shortly after the whelping season in the Kattegat-Skagerrak. Few pregnant females were found dead (n = 10) in the beginning of the epizootic and almost all pups from 1988 were hit by the disease either by being aborted, abandoned or infected (Heide-Jørgensen and Härkönen 1989). From this it appears that a full reproductive cycle has just been completed and the progeny wiped out prior to the surveys in late August. Thus, it is reasonable to compare censuses from 1988 with the anticipated (i.e. without the epizootic) number of seals in 1988.

Aerial surveys between 1978 and 1986 revealed an exponential rate of increase of 0.12 in the Kattegat-Skagerrak (Heide-Jørgensen and Härkönen 1988). Unfortunately no reliable surveys from 1987 are available except from Anholt, where the increase continued at 0.10 and 0.09 for maximum and mean numbers of seals, respectively. This is slightly less than the increase documented from aerial surveys of the entire area till 1986, hence trajectories from 1986 to 1988 will probably overestimate the actual number of seals, but the upward bias may well be negligible (Table 1A).

Among the various sources of errors inherent in these calculations the number of dead seals must be used particularly cautiously. The number of dead seals (Table 1B) does not include the autumn (1987) and winter mortality prior to the epizootic and consequently it underestimates the virtual number of seals that died between the surveys in 1987 and 1988. In addition, despite the collecting effort some dead seals were not registered. On the other hand pups that would have died from 'natural causes' during June through end of August are included, although the pregnant females that died during the epizootic reduces this error.

The epizootic killed 52 % (n = 821) males in the immature and mature (1+) segment of the population (Heide-Jørgensen and Härkönen 1989), which is more males than expected from studies of other harbour seal populations, where e.g. 47 %, 35 %, and 9 % were found among seals older than five years (Pitcher and Calkins 1979; Boulva and McLaren 1979; Bigg 1979). In addition, more mature (61 %, n = 433) than immature died than predicted from a platycurtic age structure in an increasing population.

This selective mortality has altered the age structure of the population. Different segments of the population have different affinities for haul-out and therefore surveys of seals on land may not be directly comparable before and after the epizootic. During past surveys low numbers of pups have been present on land in August (Heide-Jørgensen in litt.), and the absence of pups in 1988, will affect results from that year in an upward trend. This may, however, be counterbalanced by the reductions in males that, in other populations, are known to moult later than females (Thompson and Rothery 1987). The aerial surveys are conducted late in the moulting season and a smaller fraction of the males may be present in 1988 compared to previous years. The total effect of the assumed change in haul-out tenacity has not been evaluated in this study.

Although subject to various errors this study provides a crude estimate of the fraction of the entire population that is hauled-out during the surveys in 1988, and the estimate is of similar magnitude as those reported from radio-tagged individuals in other areas. Thompson (1987) monitored instrumented seals in Orkney, Scotland, and found that the seals were present on the haul-out site during 80 % of the days of the moulting season. In Alaska Pitcher and Calkins (1981) found that seals were hauled-out in approximately 50 % (n = 20) and 41 % (n = 13) of the days just prior to and after the moulting season.

The long-term effects of the seal plague have not been addressed in this study and the chances for recovery of the seal stocks can not be evaluated until the long-term effects have been quantified.

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Zusammenfassung

Die kurzfristigen Auswirkungen der Seehundpest in der Kattegat-Skagerrak-Region 1988

Zählungen der Seehund-Population im Kattegat und Skagerrak wurden durchgeführt, um die Auswirkungen des kürzlichen Massensterbens einzuschätzen. Sechs Luftphotozählungen sind im Jahre 1988 durchgeführt worden. Die Ergebnisse wurden mit dem Entwicklungsverlauf der Populationsgröße während der Jahre 1978–1986 verglichen. Die Anzahl der Seehunde zeigte sich um 60 % reduziert verglichen mit erwarteten Werten für das Jahr 1988. 47 % ist die entsprechende Zahl für das Jahr 1987. Die Reduktion war in drei verschiedenen Teilgebieten deutlich erkennbar, was zu dem Ergebnis führte, daß die Krankheit die gleichen Auswirkungen in allen Teilpopulationen hatte.

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